AFFECTIVE TENDENCY AS CONDITIONED BY COLOR AND FORM[1]

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CONTENTS

INTRODUCTION

This investigation studies the simultaneous effect of two aspects of a simple sensory material in conditioning affective tendency, and the nature of the affective resultant. The

[1] From the Psychological Laboratory of Clark University. The writer wishes to acknowledge his indebtedness to Dr. L. R. Geissler for suggestions in the initiation of this research.

The present article has been condensed for purposes of publication by the omission of numerous tables that present special details or represent intermediate phases of the quantitative argument and by the abbreviation or elimination of much of the discussion. A complete bound manuscript, which gives the original data, the full numerical account and a complete discussion is available under this title in the Clark University Library and can be borrowed under the usual courtesies of library exchange.

problem in its broader phase—in its bearing upon the question of summation of affections—is not new. Wundt,[2] in his analysis of affective fusion, declares that the characteristic of feeling lies in the fact that all feelings present in consciousness at a given moment tend to fuse into a unitary manifold, a *Totalgefühl,* which, nevertheless, is not a mere sum of its components, but has a unique property of its own. Külpe,[3] MacDougall[4] and Titchener,[5] on the other hand, hold that the affection of any given moment is the algebraical sum of the affections attaching to all the various sensory processes that constitute the mind at that moment.

Unfortunately, however, there seems, with a single exception,[6] to have been no systematic experimentation in support of either of these views. The question occurs, it is true, in various studies of color-harmony and of mixed feelings;[7] but these are too few in number and of too fragmentary a nature to warrant general psychological conclusions. The problem, as it stands to-day, like other problems in affective psychology, is still in controversy, pending solution by experiment.

Procedure

The present work was conducted in the psychological laboratory of Clark University during the academic year 1919-1920.

Observers.—The observers in the experiment were B, Dr. E. G. Boring, who worked with knowledge of the problem; D, Dr. L. D. Boring; F, Dr. S. W. Fernberger; M, Miss M. Bates; P, Mr. C. C. Pratt. All but M were highly trained observers and had had experience in observation under the conditions of the experiment. M soon acquired introspective facility.

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[2] W. Wundt, *Physiologische Psychologie,* 6 Aufl., 1910, II, p. 351 ff.

[3] O. Külpe, *Outlines of Psychology,* trans., 3 ed., 1909, p. 264.

[4] W. MacDougall, *Physiological Psychology,* 1905, p. 80; *Body and Mind,* 3 ed., 1915, p. 313.

[5] E. B. Titchener, *Text-book of Psychology,* 1910, p. 258.

[6] L. R. Geissler, The Affective Tone of Color-Combinations, *Titchener Commemorative Volume,* 1917, 150-174. Geissler found that the pleasantness of color-pairs increases directly with the pleasantness of the colors taken individually.

[7] Jonas Cohn: Experimentelle Untersuchungen über die Gefühlsbetonung der Farben, Helligkeiten und ihrer Combinationen, *Philos. Stud.* 10, 1894, 562-603. C. H. Johnston: The Combination of Feelings, *Harvard Psychol. Stud.,* 2, 1906, 159-191. C. E. Kellogg: Alternation and Interference of Feelings, *Psychol. Mon.,* No. 79, 1905, 95 pp. A. Wohgemuth: Pleasure-Unpleasure, *Brit. J. Psychol. Mon. Supp.,* No. 6, 1919, 252 pp.

Stimuli.—The stimuli, except in Group II, were colored forms cut from the Milton-Bradley pigment papers and pasted on squares of neutral-gray cardboard, 14.5 x 17.5 cm. The list of stimuli and their designations follows:

Group I.
- Rs: red square, 5 x 5 cm.
- Os: orange square, 5 x 5 cm.
- Ys: yellow square, 5 x 5 cm.
- Gs: green square, 5 x 5 cm.
- Cs: cyan (bluegreen) square, 5 x 5 cm.
- Bs: blue square, 5 x 5 cm.
- Ps: purple (redviolet) square, 5 x 5 cm.

Group II. Each of the following forms is drawn in black ink on a neutral-gray cardboard, 14.5 x 17.5 cm. The thickness of the line is about 0.5 mm.
- Na: equilateral triangle, 7 cm. to a side, resting on its base.
- Nb: circle, radius 2.8 cm.
- Nc: annular sector, radius of larger arc, 7.3 cm.; of smaller arc, 2.5 cm.; placed convex upward; the two sides subtend an angle of 60 degrees.
- Nd: regular pentagon, 3.8 cm. to a side, resting on one of its angles.
- Ne: regular hexagon, 3.2 cm. to a side, resting on one of its angles.
- Nf: rectangle, 6 x 4.15 cm., resting on its shorter side.
- Ng: ellipse, major axis 3.5 cm.; minor axis 2.35 cm.; major axis horizontal.

Group III. 49 colored forms, *i. e.*, every color of Group I, combined with every form of Group II. Capitals designate the color (cf. Group II). Thus,

Ra, red triangle	Yd, yellow pentagon
Rb, red circle	Cf, cyan rectangle
Oc, orange sector	Pf, purple rectangle

The brightness of the colors and the gray cardboard (N) was determined by flicker photometry under the artificial daylight of a frosted 75-watt type C-2 Mazda lamp, 15 cm. distant. The average determinations for B and the writer, reading in both directions, and expressed in per cent of baryta white mixed with velvet black paper, are:

Colored paper	R	O	Y	G	C	B	P	N
White	11.7	32.3	91.2	46.5	39.5	12.9	19.5	38.1

Method and apparatus.—The method of paired comparisons was used throughout the entire course of experimentation.

The inapplicability of the method of choice for investigating the affective value of color has been shown by Cohn.[8] The value of the method of single exposures (*Reizmethode* after M. Brahn) has been questioned by Nakashima.[9] While the serial method (method of isolated exposures) has been highly recommended by Major,[10] it is

[8] Cohn, *op. cit.*, 564.
[9] T. Nakashima, *Amer. J. Psychol.*, 20, 1909, 180.
[10] D. R. Major, *Amer. J. Psychol.*, 7, 1895, 59.

not practicable in our research because of the non-serial nature of our stimuli. The method of paired comparisons was chosen, in spite of the objections of Gordon,[11] and Bullough[12] since it is the method which has been applied by Titchener,[13] Hayes,[14] Cohn,[15] Geissler,[16] and others with some degree of success in the investigation of affective problems.

Recently Barrett,[17] having tested experimentally the relative value of the order of merit method and the method of paired comparisons, came to the conclusion that the former is "vastly to be preferred to" the latter "from the standpoint of their relative demand upon the time and energy both of the experimenter and of the subjects." This conclusion, to be sure, is legitimate as far as it goes, but the use of the order of merit method is less desirable where scientific thoroughness is required. We tried this method for testing the preference of colors and forms on over 200 students of Wellesley and Clark Colleges, and found it quite unsatisfactory because of the observers' inability to comprehend the large number of stimuli, which inevitably led to various memorial confusions, as well as to neglect of areas beyond the visual range, and because of the tendency to make mediate judgments based upon reflection or upon previously established choices, *i. e.*, the tendency to be "logical." In addition to these defects, there were spatial errors, contrast effects, extraneous associations, *etc.*

A neutral gray cardboard screen, 120 x 57 cm. on a wooden framework was erected on a table 120 x 60 cm., 76 cm. high. In the center of the cardboard were two square openings, each 10.5 x 10.5 cm., placed side by side at a distance of 9.5 cm. The table on the side towards O was covered with neutral gray cloth which hung to the floor. On E's side of the screen an oblong board, 43 x 16 cm., was hinged to the wooden frame, 19 cm. above the table, in such a manner that it could be let down towards E and two stimulus cards arranged on it side by side with each card held in place by a triangular piece of tin into which one corner slipped. When this board was snapped up by a rubber band into the upright position the stimuli came directly behind the square openings. Hinged at the top of the screen and falling toward O was a neutral gray shutter, 45 x 27 cm., which completely covered the square openings. A string was attached to the shutter from behind so that it could be lifted by E, disclosing the stimulus without letting shadow fall upon it. A vernier chronoscope[18] was used for taking reaction times. It was

[11] K. Gordon, *Psychol. Rev.*, 19, 1912. 354.
[12] L. E. Bullough, *Brit. J. Psychol.*, 2, 1908, 411ff.
[13] Titchener, *Philos. Stud.*, 20, 1902, 382ff.
[14] S. P. Hayes, *Amer. J. Psychol.*, 17, 1906, 358-393.
[15] Cohn, *op. cit.*
[16] Geissler, *op. cit.*
[17] M. Barrett, *Psychol. Rev.*, 21, 1914, 278-294.
[18] *Cf.* E. C. Sanford, The Vernier Chronoscope, *Amer. J. Psychol.*, 9, 1897-1898, 191-197.

connected with the exposure-apparatus in such a way that one of the pendulums was automatically released by an electromagnet when the shutter was raised. The other pendulum was similarly released when the reaction key was pressed by O.

O sat at a distance of 1.5 m. from the screen. The experiment took place in a dark-room. Light was furnished by two 75-watt frosted type C-2 Mazda daylight lamps, about 75 cm. behind O and a little to the right and left.

The actual procedure was as follows. At the beginning of each experiment, the ready signal was given by E who sat in the rear of the screen and manipulated the apparatus. About two seconds later, E raised the shutter and presented a pair of stimuli for three seconds. O, seated comfortably in his chair, faced the screen and announced his judgment by reacting upon a key with his right hand and stating subsequently whether his judgment has been "left" or "right." Immediately after recording O's judgment and reaction time, E shifted the stimuli and set the chronoscope for the next exposure. An interval from twenty to thirty seconds was necessary.

The experiment was continued in this fashion for the first thirty-five minutes of each session, after which a short intermission was given. The remaining time was chiefly devoted to taking introspections. B, D and F wrote their reports; M and P dictated them. It was possible to obtain about fifty comparisons and one or more introspective reports in an hour.

Instructions.—The instructions finally adopted were typewritten and read by O at the beginning of each session.

Instruction I. (For the comparison of colors.)

"In each experiment after the ready signal two colors will be exposed for a short time in the square openings of the screen. You are to give yourself up entirely to color-quality. You are to assume the attitude of passively living the color. You are not to be critical toward the stimulus or to concern yourself with extrinsic references, but to take the color simply in its own right. *Immediately* after the colors are perceived, indicate the one which you prefer as the more pleasant by pressing the key and by saying the word 'left' or the word 'right,' according as the left or the right color is preferred.

"Whenever you think you have failed to live up to this instruction, indicate that fact to the experimenter."

Instruction II. (For the comparison of forms.)

Same as Instruction I with "form" substituted for "color," and "form-aspect" substituted for "color-quality."

Instruction III. (For the comparison of color-forms.)

Same as Instruction I with "color-form" substituted for "color" and "color-quality."

When introspection was desired, the following instruction was given orally:

"In the next experiment, describe in detail your affective experience, with particular reference to the nature and mechanism of your judgment."

The observers were further instructed to indicate unambiguously cases of doubt, indecision, or of equality. D, F, M, and P were frequently unable to report upon the more pleasant stimulus, since each member of the pair was actually unpleasant; they were then allowed to base their preference upon the less unpleasant stimulus.

Order of experiment.—The experiment was divided into five parts. Parts I and V were planned to test the permanence of O's judgments upon colors and forms throughout the experimental period. The main experiment consisted of Parts II, III, and IV. Part II dealt with colors; Part III, with forms; and Part IV, with color-forms. The order for all O's but M is outlined below. M observed in the reversed order and did not participate in Parts I and V.

Part I.

Series S. The comparison of colors.

Instruction I. Stimuli, Group I (*q. v.*)
21 comparisons of colors in one spatial order, *i. e.*, each of the 7 colors compared with each of the 6 other colors, $7 \times 6/2 = 21$; and the repetiton of the same in reversed spatial order, 42 comparisons in all.

Series N. The comparison of forms.

Instruction II. Stimuli, Group II (*q. v.*)

21 comparisons of forms in one spatial order, *i. e.*, each of the 7 forms compared with each of the 6 other forms, $7 \times 6/2 = 21$; and the repetiton of the same in reversed spatial order, 42 comparisons in all.

Part II. The comparison of colors. Identical with Part I, Series S, except as to stimuli.
Instruction I. Stimuli, Group III (*q. v.*)

Series	Stimuli							
a	Ra	Oa	Ya	Ga	Ca	Ba	Pa	21 comparisons in each of 2 spatial orders for each series; $2 \times 21 =$ 42 comparisons in each series, $7 \times 42 = 294$ comparisons in all
b	Rb	Ob	Yb	Gb	Cb	Bb	Pb	
c	Rc	Oc	Yc	Gc	Cc	Bc	Pc	
d	Rd	Od	Yd	Gd	Cd	Bd	Pd	
e	Re	Oe	Ye	Ge	Ce	Be	Pe	
f	Rf	Of	Yf	Gf	Cf	Bf	Pf	
g	Rg	Og	Yg	Gg	Cg	Bg	Pg	

Part III. The comparison of forms. Identical with Part I, Series N, except as to stimuli.

Instruction II. Stimuli, Group III.

Series	Stimuli							
R	Ra	Rb	Rc	Rd	Re	Rf	Rg	21 comparisons in each of 2 spatial orders for each series; 2 x 21 = 42 comparisons in each series, 7 x 42 = 294 comparisons in all.
O	Oa	Ob	Oc	Od	Oe	Of	Og	
Y	Ya	Yb	Yc	Yd	Ye	Yf	Yg	
G	Ga	Gb	Gc	Gd	Ge	Gf	Gg	
C	Ca	Cb	Cc	Cd	Ce	Cf	Cg	
B	Ba	Bb	Bc	Bd	Be	Bf	Bg	
P	Pa	Pb	Pc	Pd	Pe	Pf	Pg	

Part IV. The comparison of color-forms.

Instruction III. Stimuli, Group III. Series 1 to 24 inclusive.

1176 comparisons of color forms in one spatial order only, *i. e.*, each of the 49 color-forms compared with each of the other color-forms, $49 \times 48/2 = 1176$. Series 1 and 2 consisted of 42 comparisons each; series 3, of 63; and each of the rest, of 49.

Part V.

Series S′ = Repetition of Part I, Series S.
Series N′ = Repetition of Part I, Series N.

The stimuli were presented in haphazard order, with the precaution that no stimulus should appear twice in succession. The same stimuli, differently arranged, were used in Parts II, III, and IV. Thus, the isolation of color (Part II) and of form (Part III) was accomplished solely by the direction of attention. It would, of course, be ideal if we were able to present formless colors and colorless forms for the experiments on colors and forms. The use of the same stimuli in all parts of the main experiment did not, however, introduce any measurable disadvantage in the investigation, for the observers acquired skill in isolating under attention the color or form from the color-form and in attending to the one or the other separately.

Affective Judgment under the Method of Paired Comparisons

At the outset of this investigation, we had no definite knowledge regarding the practicability of the method of paired comparisons in dealing with our particular problem, nor did we have any exact conception of the nature of affections induced under this method. The choice of the method was quite arbitrary; it was, however, the only purely psychological method available, the only method that experimentalists might agree upon as furnishing the conditions or definition of the

generally conceded affective process. We found, as have our predecessors, that the results obtained with this method are of a positive character as far as their quantitative aspect is concerned, and that pleasantness and unpleasantness are not only reportable, but that judgments upon them may be nearly as immediate as judgments upon sensory impressions. Nevertheless the observers worked under very different attitudes and, so far as their introspective reports are admissible as evidence, we found their judgments based upon different sorts of psychological processes. This divergence in type of judgment led to less inconsistency in the nature of the data than might be expected, although the introduction of a critical introspective attitude undoubtedly accounts for the instability of some of the results. A characterization of these differences is in place here, since it reflects the limitations of the method; a critical study of the introspections which show these differences must, however, wait for a later article.

In a preliminary survey of the introspective data of our four practiced subjects, it appears that the affective judgments may be of two distinct types which depend upon two different attitudes,—a sensorial attitude and an objective attitude. The sensorial attitude presumably grew out of an instruction for introspection. Either the observers understood the instruction that they were sometimes to report introspectively upon the judging process to mean that they were to judge processes, or else the general introspective habits of the laboratory operated toward a similar self-instruction. The fact seems to be that the observers who sought to base their judgments upon introspectable material tended actually to base them upon sensory process, and that this introspective attitude is actually a sensorial attitude. Observer B's judgments were of this type. He approached the experiment with a firm conviction that if the affection is an existential mental process, it must be directly observable by introspection and his attitude throughout the experiment was characteristically introspective. He found, however, that pleasantness and unpleasantness were for him nonexistential in this psychological sense, that they were always 'meanings' or conscious attitudes based definitely under these particular conditions upon some particular sensory pattern. In order to make an affective judgment, however, it was always necessary for him to have some essential sensory cue, and his reaction-times, which were comparatively long, reflect this intervention of a sensory mediator between the perception of the stimulus and the arousal of the judgment. D also worked in the sensorial atti-

tude, characterizing affections as meanings carried by organic sensations. P reported them as observable psychological elements, but concomitant with organic and kinaesthetic processes. F, on the other hand, approximated the objective attitude, under which the stimulus is focal and introspected process is of secondary account. This attitude is in the spirit of the major instructions and F followed these instructions uncritically and was very receptive. His judgments after a little practice became mechanized and quick, as might have been expected, since there appeared to be no process-intermediary to retard the course. Although he became, during the course of the experiment, convinced that judgments of preference might be made without the presence of either of the affective qualities, he believed, nevertheless, that pleasantness and unpleasantness do exist as mental elements.

These results are especially suggestive in so far as they throw light upon the question of the psychological status of affection and the manner in which the problem of meaning enters into the problem of feeling. It is nothing new for observers in the same experiment to disagree over the nature of affection,[19] and the applicability of the introspective method is seriously open to question. Nevertheless the problem needs to be faced in the light of protocols obtained from observers trained in the introspective method and with their wits keen to note the incursions of meaning and *Kundgabe* upon the field of existential process. This issue remains; it is not immediately involved in the present problem, and it seems preferable to reserve it for separate treatment later.

It has seemed advisable tentatively to adopt the term "affective tendency" in this study because the entities involved (number of preferences) are statistical data and not immediately given and because the conceptual bases of the affective judgment must necessarily be as little directly observable as are the associative and determining tendencies. The difficulties and divergences of our observers emphasize again the elusiveness of the immediately observable affective datum, and the experiment as a whole brings to the fore what seems to be the available material at the bottom of the experimentalist's belief in affection, *viz.*, the statistical relative frequencies of preferences. And the term tendency, so it seems, is used by psychologists to represent those mental entities that appear thus in statistical settings.

[19] Nakashima, Contributions to the Study of the Affective Processes, *Amer. J. Psychol.*, 20, 1909, 180ff.

TABLE I

PERMANENCY OF AFFECTIVE JUDGMENT

Percents of agreement between early series (Part I; S, N) and late series (Part V; S^1, N^1). S and S^1 are for colored squares; N and N^1 for "neutral" forms. Obs.: B, D, F, P. Colors O and P omitted in |"B (revised.)"

	B	D	F	P	B (Revised)
S & S^1	64.3	90.5	100.0	92.9	90.0
N & N^1	90.5	95.2	100.0	88.1	90.5

Degree of Permanency of Affective Judgment (Results of Parts I and V; Instructions I and II.)

Table I indicates in terms of percentages of agreement,[20] the degree of permanence of O's affective judgments on colors and on forms just before (Part I) and after (Part V) the main experiment. Inspection will show clearly that, except in case of B, the influence of time,—as might be expected from the result of Bradford,[21]—is too small to change the preferential order of colors and forms. The low degree of consistency of B's judgments on colors is due apparently to a change in his preference for purple and orange during the progress of experiment. The omission of orange and purple from calculation of B's results gives a much higher percentage of agreement for colors without causing any change for forms (Table I, last column).

Of this change B remarked: "Purple became more pleasant than it used to be. I liked it better than red." Since the objective conditons of experiment have been kept fairly constant throughout and since no other salient cause is discoverable, we are justified in attributing B's change to the relative inconstancy of his attitude during the long interval of time. On the other hand, having shown that the degree of consistency of our observers' affective judgments in general is high and that therefore the preferential order for colors and for forms is not the result of transient conditions, we may

[20] See W. S. Foster and K. Roese, Tridimensional Theory of Feeling from the Standpoint of Typical Experiences, *Amer. J. Psychol.*, 27, 1916, 161, for the calculation of these. Our "per cent of agreement" is obtained by multiplying their 'degree of similarity' by 100.

[21] E. J. C. Bradford, A Note on the Relation and Aesthetic Value of the Perceptive Types in Color Appreciation, *ibid.*, 24, 1913, 545-554.

safely conclude that the affective tendency of colors and forms can be determined psychophysically in experimental series extending over as long a period as that of our main experiment (Parts II, III, IV).

TABLE II

MUTUAL INDEPENDENCE OF COLOR AND FORM: OBS. B.

Upper right half of the table shows percents of agreement for colors between every pair of forms; attention on color (Instruction I.) Lower left half of the table shows percents of agreement for forms between every pair of colors; attention on form (Instruction II.)

Av. for Color = 80.3; M.V. = 5.0

COLOR

		b	c	d	e	f	g	Form
		88.1	81.0	78.6	69.0	88.1	78.6	a
O	90.5		88.1	85.7	71.4	88.1	78.6	b
Y	90.5	90.5		81.0	69.0	81.0	73.8	c
G	88.1	90.5	92.9		71.4	90.5	81.0	d
C	88.1	90.5	92.9	100.0		76.2	88.1	e
B	81.0	85.7	90.5	95.2	95.2		85.7	f
P	88.1	95.2	88.1	90.5	90.5	85.7		
Color	R	O	Y	G	C	B		

FORM

Av. for form = 90.5; M. V. = 2.7

TABLE III

MUTUAL INDEPENDENCE OF COLOR AND FORM: OBS. D

See Legend of Table II

Av. for color = 90.7; M. V. = 3.2

COLOR

		b	c	d	e	f	g	Form
		95.2	95.2	92.9	85.7	95.2	85.7	a
O	85.7		95.2	95.2	88.1	90.5	88.1	b
Y	95.2	83.3		92.9	90.5	95.2	90.5	c
G	90.5	81.0	85.7		83.3	90.5	88.1	d
C	95.2	85.7	95.2	85.7		85.7	92.9	e
B	90.5	81.0	85.7	90.5	85.7		88.1	f
P	90.5	90.5	85.7	90.5	85.7	90.5		
Color	R	O	Y	G	C	B		

FORM

Av. for form = 88.1; M. V. = 3.6

TABLE IV

MUTUAL INDEPENDENCE OF COLOR AND FORM: OBS. F.

See Legend of Table II

Av. for color = 94.8; M. V. = 2.2

		COLOR b	c	d	e	f	g	Form
		95.2	90.5	95.2	90.5	100.0	100.0	a
O	90.5		95.2	95.2	95.2	95.2	95.2	b
Y	95.2	95.2		95.2	100.0	90.5	90.5	c
G	90.5	90.5	95.2		95.2	95.2	95.2	d
C	95.2	85.7	90.5	85.7		90.5	90.5	e
B	95.2	95.2	100.0	95.2	90.5		100.0	f
P	95.2	95.2	100.0	95.2	90.5	100.0		
Color	R	O	Y	G	C	B		

FORM

Av. for form = 93.7; M. V. = 3.3

TABLE V

MUTUAL INDEPENDENCE OF COLOR AND FORM: OBS. M.

See Legend of Table II

Av. for color = 82.0; M. V. = 5.5

		COLOR b	c	d	e	f	g	Form
		76.2	71.4	81.0	76.2	76.2	81.0	a
O	90.5		85.7	95.2	81.0	88.1	90.5	b
Y	71.5	76.2		85.7	76.2	76.2	76.2	c
G	76.2	76.2	66.7		85.7	85.7	90.5	d
C	66.7	76.2	90.5	76.2		90.5	76.2	e
B	76.2	85.7	71.4	85.7	76.2		81.0	f
P	81.0	88.1	76.2	81.0	76.2	90.5		
Color	R	O	Y	G	C	B		

FORM

Av. for form = 78.8; M. V. = 6.0

TABLE VI

MUTUAL INDEPENDENCE OF COLOR AND FORM: OBS. P.

See Legend of Table II

Av. for color = 91.8; M. V. = 3.4

COLOR

		b	c	d	e	f	g	Form
		97.6	81.0	90.5	92.9	97.6	92.9	a
O	85.7		85.7	92.9	95.2	100.0	92.9	b
Y	95.2	90.5		92.9	90.5	85.7	88.1	c
G	90.5	92.9	88.1		92.9	92.9	85.7	d
C	95.2	90.5	90.5	95.2		95.2	92.9	e
B	90.5	95.2	95.2	92.9	95.2		92.9	f
P	90.5	90.5	85.7	95.2	95.2	90.5		
Color	R	O	Y	G	C	B		

FORM

Av. for form = 91.9; M. V. = 2.7

TABLE VII

MUTUAL INDEPENDENCE OF COLOR AND FORM: REVISED RESULT OF OBS. B.

See Legend of Table II. Colors O and P omitted because of inconstancy.

Av. for color = 86.7; M. V. = 5.6

COLOR

		b	c	d	e	f	g	Form
		95.0	85.0	90.0	80.0	95.0	95.0	a
Y	90.5		85.0	90.0	85.0	90.0	100.0	b
G	88.1	92.9		85.0	70.0	85.0	85.0	c
C	88.1	92.9	100.0		75.0	90.0	90.0	d
B	81.0	90.5	95.2	95.2		75.0	85.0	e
							90.0	f
Color	R	Y	G	C				

FORM

Av. for form = 91.4; M. V. = 3.8

Mutual Independence of Color and Form in Conditioning Affective Tendency of Color and Form respectively under Attentive Isolation (Results of Parts II and III, Instructions I and II.)

The results of Parts II and III are summarized in Tables II-VII. Each number in the upper right half of these tables is a percentage of agreement between the preferential order of colors of one form and the preferential order of the same colors with another form. The numbers in the lower left half are percentages of agreement of the preferential order of forms for pairs of colors. For example, in Table II, the figure 88.1 below 'f' and opposite 'a' is the percentage of agreement between the order of colors of series f (colors of form f) and the order of colors of series d (colors of form d); 90.5 above "R" and opposite "O" in the same table is the agreement between the preferential order of forms colored R and the order of forms colored O.

The percentages of agreement between the various series for both color and form are very high, ranging from 61.9 to 100.0 in case of the former, and from 66.7 to 100.0 in the latter. The averages of all the observers are 87.9 for color and 88.1 for form with the M. V's 3.9 and 3.7 respectively. These agreements are high enough to warrant a conclusion that when color-forms are presented for affective comparison of colors only, the forms have practically no influence upon the preferential order of these colors, provided the observer's attitude remains constant throughout the task, and that color similarly has practically no effect upon form. Color and form, then, may be said to be each independent of the other in conditioning affective tendency where each is isolated from the other by attentive abstraction.

This conclusion follows even in the face of relatively low degree of consistency of M's affective judgments on color and form and of B's on color. In B's case, as we have noted, purple and orange proved always the disturbing factors in his otherwise regular preferences. The M. V's of the scores of these colors were each greater than one-fourth of their averages. The inconsistency is plainly conditioned upon the nature of these two colors and not in any way upon form. (See Table VII, 'revised result' for B.) The case of M is of more significance, as these experiments were performed after she had completed 1176 comparisons of color-forms, and she was therefore expected to have a fixed set of preferential orders. However, there is no reason to assume that her failure to attain a higher degree of consistency is to be attributed to the mutual influence of color and form, exhibited

by no other observer; rather it is reasonable to believe that, being untrained in psychological experimentation, she misunderstood the instructions, attempting to secure speed rather than accuracy. Moreover, it may be that she worked with various criteria of pleasantness, without sufficient discrimination, and thus gave inconstant results. These indications are borne out by her extraordinarily short reaction times and her frequent premature judgments, as well as by her own introspections, in which not infrequently are found such sentences as: " I chose the right in spite of myself," " the left was so impressive that I judged it as more pleasant, though I knew I liked the right better." It is also pertinent to observe that she had no decided preference among the forms as she did among the colors, and that the degree of consistency for forms is therefore even lower than for colors.

TABLE VIII

AFFECTIVE VALUES OF COLOR-FORMS: OBS. B.

Number of preferences under method of paired comparisons for every colored form with attention on color-form (Instruction III). Rows show comparisons of forms for every color; columns show comparisons of colors for every form.

	a	b	c	d	e	f	g	Av.	M.V.
R	32.5	48.0	29.5	35.5	38.0	37.5	42.0	37.6	4.37
O	10.0	24.5	1.5	11.5	25.5	10.5	19.5	14.7	7.24
Y	17.0	41.0	17.0	25.5	27.0	15.5	29.5	24.6	6.98
G	24.5	36.0	25.0	28.0	34.5	28.5	36.5	30.4	4.50
C	2.5	25.0	3.5	7.0	11.5	3.0	10.0	8.9	5.68
B	14.5	39.0	18.5	24.5	30.0	17.5	34.0	25.4	7.64
P	20.5	38.0	13.0	25.0	31.0	21.0	35.5	26.3	7.33
Av.	17.3	35.8	15.4	22.4	28.2	19.1	29.6		6.25
M. V.	7.26	6.45	8.08	7.53	5.90	8.51	8.49	7.46	

TABLE IX

AFFECTIVE VALUES OF COLOR-FORMS: OBS. D.

See Legend of Table VIII

	a	b	c	d	e	f	g	Av.	M.V.
R	35.0	35.0	41.0	41.0	38.0	33.0	37.5	37.2	2.47
O	8.0	1.0	18.0	16.0	11.5	0.0	2.0	8.1	6.08
Y	15.5	7.0	30.0	28.0	22.0	4.0	7.0	16.2	8.96
G	12.0	8.0	28.0	25.0	18.0	6.5	11.0	15.5	7.00
C	25.0	21.0	34.0	33.5	27.0	16.0	23.0	25.6	5.02
B	45.0	42.0	48.0	46.0	45.0	42.0	43.0	44.5	1.79
P	25.0	15.5	32.0	31.0	20.0	7.0	16.0	20.9	7.20
Av.	23.6	18.5	33.0	31.5	25.9	15.5	19.9		5.50
M.V.	10.12	12.14	6.86	7.43	9.20	12.71	12.49	10.14	

TABLE X

AFFECTIVE VALUES OF COLOR-FORMS: OBS. F.

See Legend of Table VIII

	a	b	c	d	e	f	g	Av.	M.V.
R	38	37	47	35	31	19	43	35.7	6.33
O	32	27	44	27	22	14	42	30.0	8.29
Y	21	19	37	14	11	7	31	19.7	8.24
G	6	2	13	4	1	0	7	4.7	3.39
C	16	14	27	12	8	7	25	15.7	6.10
B	41	40	48	37	33	23	46	38.3	6.24
P	26	24	38	21	15	10	33	23.9	7.31
Av.	25.7	23.4	36.1	21.6	17.3	11.4	32.4		6.56
M.V.	9.76	9.94	9.37	11.37	9.76	6.20	9.80	9.46	

TABLE XI

AFFECTIVE VALUES OF COLOR-FORMS: OBS. M.

See Legend of Table VIII

	a	b	c	d	e	f	g	Av.	M.V.
R	29.0	45.0	36.0	41.0	41.0	27.0	43.0	37.4	5.80
O	13.0	24.0	19.0	18.0	27.5	17.5	24.5	20.5	4.14
Y	10.0	35.0	28.0	24.0	26.0	17.0	32.0	24.6	6.49
G	10.0	12.0	6.5	3.5	11.0	5.0	20.0	9.7	4.04
C	14.5	25.0	14.5	13.0	11.5	7.5	15.0	14.4	3.22
B	34.0	47.0	44.0	40.0	42.0	32.0	44.0	40.4	4.37
P	12.5	30.0	26.0	24.0	22.5	10.5	21.0	20.9	5.39
Av.	17.6	31.1	24.9	23.4	25.9	16.6	28.5		4.78
M.V.	7.96	9.59	9.88	10.16	9.37	7.69	9.57	9.17	

TABLE XII

AFFECTIVE VALUES OF COLOR-FORMS: OBS. P.

See Legend of Table VIII

	a	b	c	d	e	f	g	Av.	M.V.
R	27.5	34.0	35.0	35.0	45.0	16.5	47.0	34.3	7.10
O	24.0	28.0	29.0	36.0	39.0	17.0	44.0	31.0	7.43
Y	21.0	23.0	23.0	32.0	36.0	17.0	40.0	27.4	7.35
G	6.5	5.0	6.5	8.5	10.0	2.5	13.5	7.5	2.79
C	7.5	8.5	8.5	8.5	11.0	1.0	17.5	8.9	3.04
B	33.0	38.0	37.0	40.0	46.0	27.0	47.0	38.3	5.18
P	19.0	15.0	16.5	23.0	30.0	10.5	30.0	20.6	6.08
Av.	19.8	21.6	22.2	26.7	31.0	13.1	34.1		5.57
M.V.	7.53	10.41	10.04	10.89	12.00	7.20	11.84	9.99	

TABLE XIII

AFFECTIVE VALUES OF COLOR-FORMS: REVISED RESULT OF OBS. B

See legend of Table VIII. Colors O and P omitted because of inconstancy.

	a	b	c	d	e	f	g	Av.	M.V.
R	22.5	34.0	19.0	23.5	26.0	24.5	29.0	25.5	3.21
Y	11.5	28.5	9.0	16.5	17.0	10.5	19.5	16.1	4.92
G	15.5	25.5	17.0	19.0	25.0	20.5	25.0	21.1	3.51
C	1.5	16.5	1.0	4.0	7.0	2.5	6.5	5.6	3.80
B	9.5	27.5	11.0	17.5	20.0	8.5	23.5	16.8	6.10
Av.	12.1	26.4	11.4	16.1	19.0	13.3	20.7		4.31
M.V.	5.52	4.32	5.48	4.84	5.60	7.36	6.16	5.61	

Concurrent Operation of Color and Form upon Affective Tendency (Parts II, III and IV).

Affective values of color-forms. (Part IV; Instruction III.)—Tables VIII-XIII inclusive give the result of Part IV, the experiment upon the forty-nine stimuli with attention upon "color-form." In each table the figures in the first seven rows and columns are the absolute frequencies of choice made upon these color-forms by each observer. Further, these tables are so arranged that each row contains the scores of seven color-forms, different from one another in form and identical in color, and thus show implicitly the preferential order of seven forms, all of the same color; while, conversely, each column exhibits the preferential order of seven colors, all in the same form. The averages and M.V's are respectively placed in the rows and columns so named. For example, let us take Table VIII (Obs. B). The figures 32.5, 48, 29.5, *etc.*, respectively under a, b, c, *etc.*, in the row R indicate the scores of the color-forms, Ra, Rb, Rc, *etc.*, establishing the preferential order of the forms, a, b, c, *etc.*, for the color red. Likewise, the figures, 48, 24.5, 41, *etc.*, respectively opposite R, O, Y, *etc.*, in the column b may be taken either as the number of choices of the color-forms, Rb, Ob, Yb, *etc.*, or as indicative of the preferential order of the colors, R, O, Y, *etc.*, in the form b, the circle.

Effect of instruction upon preference. (Comparison of Parts II and III with IV.)—In order to measure the influence of the direction of attention upon affective tendency, the preferential orders of colors with attention directed upon color only (Part II, Instruction I) and of forms with atten-

TABLE XIV

EFFECT OF DIRECTION OF ATTENTION

Correlation for colors between ranks with attention on color-quality (Instruction I) and ranks with attention on color-form (Instruction III). "Av." = av. correlation and av. P.E. "M. V." = M.V. of "Av." "Correl. Av." = correlation of av. of all forms for every obs. "B (revised)" = B's results with colors O and P omitted.

Obs.	B		D		F		M		P		Av. for All obs.		B (revised)	
Form	ρ	P.E.	ρ	P.E.	ρ	P.E.	ρ	P.E.	ρ	P.E.	ρ	P.E.	ρ	P.E.
a	0.86	0.07	0.92	0.04	1.00	0.00	0.43	0.22	0.96	0.02	0.83	0.07	0.88	0.07
b	0.56	0.17	0.88	0.06	1.00	0.00	0.87	0.07	0.99	0.01	0.86	0.06	0.55	0.22
c	0.90	0.05	0.99	0.01	0.96	0.02	0.93	0.04	0.98	0.01	0.95	0.02	0.90	0.06
d	0.46	0.21	0.94	0.03	0.99	0.01	0.90	0.05	0.94	0.03	0.85	0.07	0.88	0.07
e	0.64	0.16	0.94	0.03	0.96	0.02	0.74	0.12	1.00	0.00	0.86	0.07	0.90	0.06
f	0.63	0.16	0.85	0.08	0.99	0.01	0.81	0.09	0.83	0.08	0.82	0.08	0.90	0.06
g	0.67	0.15	1.00	0.00	1.00	0.00	0.88	0.06	0.93	0.04	0.90	0.05	0.95	0.03
Av.	0.68	0.14	0.93	0.03	0.99	0.01	0.89	0.09	0.95	0.03	0.87	0.06	0.85	0.09
M. V.	0.12		0.04		0.01		0.12		0.04		0.03		0.09	
Correl. Av.	0.74	0.12	1.00	0.00	1.00	0.00	0.96	0.02	1.00	0.00	0.94	0.03	0.90	0.06

TABLE XV

EFFECT OF DIRECTION OF ATTENTION

Correlation for forms between ranks with attention on form-aspect (Instruction II) and ranks with attention on color-form (Instruction III). "Av." = av. correlation and av. P.E. "M. V." = M.V. of "Av." "Correl. Av." = correlation of av. of all colors for every obs. "B (revised)" = B's results with colors O and P omitted.

Obs.	B		D		F		M		P		Av. for All obs.		B (revised)	
Color:	ρ	P.E.	ρ	P.E.	ρ	P.E.	ρ	P.E.	ρ	P.E.	ρ	P.E.	ρ	P.E.
R	0.89	0.05	0.94	0.03	1.00	0.00	0.26	0.25	0.92	0.04	0.80	0.04	0.90	0.05
O	0.86	0.07	0.96	0.02	0.94	0.03	0.56	0.18	0.89	0.05	0.84	0.07	....	....
Y	0.88	0.06	0.93	0.04	0.99	0.01	0.39	0.23	0.96	0.02	0.83	0.07	0.96	0.02
G	0.89	0.05	0.96	0.02	0.89	0.05	0.21	0.26	0.88	0.06	0.77	0.09	0.92	0.04
C	0.86	0.07	0.96	0.02	1.00	0.00	0.19	0.26	0.96	0.02	0.79	0.07	0.96	0.02
B	0.82	0.09	0.98	0.01	0.99	0.01	0.62	0.17	0.99	0.01	0.88	0.06	0.75	0.12
P	0.96	0.02	0.96	0.02	0.99	0.01	0.77	0.11	0.80	0.10	0.90	0.05	....	....
Av.	0.88	0.05	0.95	0.02	0.97	0.02	0.43	0.21	0.92	0.03	0.83	0.07	0.90	0.03
M. V.	0.03		0.02		0.03		0.19		0.05		0.04		0.06	
Correl. Av.	1.00	0.00	1.00	0.00	1.00	0.00	0.46	0.21	0.96	0.02	0.89	0.05	1.00	0.00

tion directed upon form only (Part III, Instruction II) were compared by the method of rank-differences with the results for color and form respectively with attention upon 'color-form' (Part IV, Instruction III). The correlations are indicated in Tables XIV (color) and XV (form).[22] In table XIV, 0.90 under "ρ" and opposite "c," for instance, is the

coefficient of correlation between the preferential orders of colors of the form c obtained in Part II and in Part IV; the figure 0.05 adjacent to it is the probable error of this ρ. Similarly, in Table XV, the figure 0.89 under " " and opposite " R " is the coefficient of correlation between the preferential orders of forms of the color red obtained in Part II and in Part IV, *etc.*

Examination of these tables reveals the fact that the coefficients of correlation, whether they be between the preferential orders of clors or of forms, are high for the observers D, F, and P, never falling below 0.80 and never with the P.E. exceeding one tenth of ρ. Indeed, for these observers, the correlation is perfect or nearly so when computed for the average ranks of colors or of forms. (Table XIV, row 'Correl. Av.', and Table XV, row 'Correl. Av.'.) With B (color) and M (both color and form), the correlation is less significant than with the other observers.

It might be argued *a priori* that the poor result of M is due mainly to the fact that she had worked with the color-forms before she worked with the separate colors and forms, and that thus her judgments of the color-forms were relatively independent of the affective tendencies intrinsic to the colors and forms. Since Geissler, however, has already proved in his investigation of the influence of the affective tone of single colors on the affective tone of their combinations that there is no difference in the actual result whether the individual colors are presented before or after the color-pairs,[23] the writer is inclined to question the validity of any such claim. The more salient causes for the instability of her judgments seem to lie in the precarious nature of her attitude and her apparent lack of decided preference for any particular forms (see above). B's low correlation for the colors (0.77) results from the inconstancy of his judgments with the orange and purple stimuli. The recalculation of his data after eliminating the judgments on all the orange and purple stimuli raises the coefficient of correlation (Tables XIV and XV, last column) greatly between Part II and IV and between Part III and IV.

Taken all in all, there is a high degree of correspondence between the results of Parts II and III, and Part IV for all the observers, thus indicating that color and form operate as affective conditions independently of the direction of attention.

Degree of independence of color and form in conditioning affective tendency of color-form.—The failure to attain per-

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[22] The formulae used were: $\rho = 1 - \frac{6 \Sigma D^2}{n (n^2 - 1)}$, and

$\text{P.E.}_\rho = 0.706 \frac{1-\rho^2}{n}$.

[23] Geissler, *op. cit.*

fect correlations in the foregoing analysis may be attributed either to fluctuations of the observers' attitude under a given *Aufgabe,* or to the mutual effect of color and form upon the preferential order for each when the two are combined and judged as color-forms. Accordingly, if for the sake of simplicity we ignore, for a moment, the first of these factors (although there is every reason to believe that it was an important cause in effecting the inconstant results) and consider the data as indicative of mutual effects only, then the coefficients of correlation may be looked upon as the indices of the degrees of independence of color and form, one from another, as they condition the affective tendencies of the color-forms; and, conversely, the differences of these coefficients from unity may be taken as the measure of the degree of their mutual effect. It may be readily seen in Tables XIV and XV that, except in the cases of B and M, the effect is not very marked (ave. effects of forms on colors $= 1.00 - 0.87 = 0.13$, of colors on forms $= 1.00 - 0.83 = 0.17$). The variations (M.V's) between the effects of different colors and forms are comparatively large; yet no definite relation can be found between the relative effects of these colors and forms, and the relative intensities of their own affective tendencies. It is doubtful whether these variations are at all the result of interaction of color and form. That they might easily be due to vacillations in the observer's attitude appears from the fact that they vary from observer to observer according to the order of the inconstancy of attitude. (See analysis of Parts I, II and III). At any rate we may conclude that as far as relative pleasantness is concerned, color and form are, in the main, mutually independent in conditioning affective tendency of color-form.

TABLE XVI

RELATIVE EFFECTIVENESS OF SEPARATE COLORS IN CONDITIONING AFFECTIVE TENDENCY OF COLOR-FORM

Inversely measured by M. V. of different forms for every color. Values taken from last columns, Tables VIII-XIII. Rank orders of effectiveness in parentheses.

Obs.:		B	D	F	M	P	Av. for All obs.	B (revised)
For the 7 forms in:	R	4.37 (1)	2.47 (2)	6.33 (4)	5.80 (6)	7.10 (5)	5.21 (4)	3.21 (1)
	O	7.24 (5)	6.08 (4)	8.29 (7)	4.14 (3)	7.43 (7)	6.64 (5)	.... ..
	Y	6.98 (4)	8.96 (7)	8.24 (6)	6.49 (7)	7.35 (6)	7.59 (7)	4.92 (4)
	G	4.50 (2)	7.00 (5)	3.39 (1)	4.04 (2)	2.79 (1)	4.34 (1)	3.51 (2)
	C	5.68 (3)	5.02 (3)	6.10 (2)	3.22 (1)	3.04 (2)	4.61 (2)	3.80 (3)
	B	7.64 (7)	1.79 (1)	6.24 (3)	4.37 (4)	5.18 (3)	5.04 (3)	6.10 (5)
	P	7.33 (6)	7.20 (6)	7.31 (5)	5.39 (5)	6.08 (4)	6.66 (6)	.... ..
Av.		6.25	5.50	6.56	4.78	5.57	5.73	4.31

TABLE XVII

RELATIVE EFFECTIVENESS OF SEPARATE FORMS IN CONDITIONING AFFECTIVE TENDENCY OF COLOR-FORM

Inversely measured by M.V. of different colors for every form. Values taken from last rows, Tables VIII-XIII. Rank orders of effectiveness in parentheses.

Obs.:	B	D	F	M	P	Av. for All Obs.	B (revised)
For the 7 colors in: a	7.26 (3)	10.12 (4)	9.76 (4)	7.96 (2)	7.53 (2)	8.53 (2)	5.52 (4)
b	6.45 (2)	12.14 (5)	9.94 (6)	9.59 (5)	10.41 (4)	9.51 (6)	4.32 (1)
c	8.08 (5)	6.86 (1)	9.37 (2)	9.88 (6)	10.04 (3)	8.85 (3)	5.48 (3)
d	7.53 (4)	7.43 (2)	11.37 (7)	10.16 (7)	10.89 (5)	9.48 (5)	4.84 (2)
e	5.90 (1)	9.20 (3)	9.76 (3)	9.37 (3)	12.00 (7)	9.25 (4)	5.60 (5)
f	8.51 (7)	12.71 (7)	6.20 (1)	7.69 (1)	7.20 (1)	8.46 (1)	7.36 (7)
g	8.49 (6)	12.49 (6)	9.80 (5)	9.57 (4)	11.84 (6)	10.44 (7)	6.16 (6)
Av.	7.47	10.14	9.46	9.17	9.99	9.24	5.61

Dominance of color or form as independently conditioning affective tendency of color-form.—Let us inquire next whether color or form is more dominant in independently conditioning the affective tendency of color-form, and further, as to the relative effectiveness of separate colors and forms in such an operation.

It is evident that if the colors and forms were equally effective, the scatter of the scores of the forms in each color would tend to be equal to that of the colors in each form; and, if colors and forms were unequally effective, the scatter would be different. Again, if any color or form were more effective than the others, the scores of the forms of that color or of the colors of that form would cluster more closely together than the scores of the forms of any other colors or of the colors of any other forms. Obviously, therefore, the effectiveness of each of the seven colors is measured by the M.V. of the scores of the seven forms used in that color. A scale of the relative effectivness of these colors may be based upon the comparison of these M.V's, with effectiveness inversely proportional to the M.V's. In the same way, the effectiveness of each of the seven forms can be measured in terms of the M.V. of the scores of the seven colors used in that form, and a scale similarly constructed for them.

These M.V's have been computed and are indicated in the right-hand columns and in the bottom rows of Tables VIII-XIII. They are reproduced in Tables XVI and XVII with the ranks (in parentheses) of the colors and forms according to their relative effectiveness. On the whole, the colors thus appear more effective than the forms in determining the affective tendencies of the color-forms.

The relative effectiveness of every color and form (Tables XVI and XVII) has been compared with its relative pleasantness (Part II, Instruction I, and Part III, Instruction II) with the following result:

The first three most effective colors are for the observer:
B, the 2 most pleasant and the 1 least pleasant colors.
D, the 2 most pleasant and the 1 moderately pleasant colors.
F, the 1 most pleasant and the 2 least pleasant colors.
M, the 1 most pleasant and the 2 least pleasant colors.
P, the 1 most pleasant and the 2 least pleasant colors.

The first three most effective forms are for the observer:
B, the forms which rank 3, 1, and 6.
D, the 3 most pleasant forms.
F, the 1 most pleasant and the 2 least pleasant forms.
M, the 1 most pleasant and the 1 least pleasant and 1 moderately pleasant forms.
P, the 3 least pleasant forms.

In other words the extremes, *i.e.* the most pleasant and the least pleasant colors and forms, were the most effective. These extremes must represent the most intensive affective degrees, since all observers except B testified that the least pleasant stimuli were actually intensively unpleasant. It appears, therefore, that the dominance of color or form as independently determining the affective tendency of color-form depends directly upon the intensity of its pleasantness and unpleasantness.

Summation of affective tendencies.—We have seen that the high degree of correspondence between the results of Part II and III (attention on color or form alone) and of Part IV (attention on color-form) indicates that both color and form were simultaneously effective in conditioning the pleasantness of a colored form when the attention was directed by instruction upon both the color and form aspects; and that color and form operate simultaneously in conditioning affective judgment in the same manner that each operates when attended to separately. We have seen further that the relative effectiveness of color and form in simultaneous operation is dependent upon the effectiveness of each when operating in attentive isolation. Now to say that color and form thus work independently and simultaneously to establish affective tendency in the way in which each works separately is to state that the two summate. Since we are dealing here with ranks and lack exact measurements of the amount of the affective tendencies involved, we can not, of course, state that summation occurs in any exact arithmetical sense, but the general law that their effects are algebraically additive can not be

denied. Remembering that four of the five observers made judgments at times upon the relative unpleasantness of the stimuli, we may lay down the rule: *Within the dimension of pleasantness and unpleasantness, the affective tendency of color-form varies approximately with the algebraical sum of the affective tendencies of its constituent color and form.*

TABLE XVIII

EFFECT OF DIRECTION OF ATTENTION: PRELIMINARY EXPERIMENT

Preferential order of colors: correlation between ranks for colored squares, and ranks for colors of various forms. (12 obs.; 1st 4 women.)

Obs.:	1	2	3	4	5	6	7	8	9	10	11	12
ρ:	0.97	0.94	0.93	0.97	0.93	0.97	0.89	0.90	0.94	0.99	0.99	0.97

TABLE XIX

EFFECT OF DIRECTION OF ATTENTION: PRELIMINARY EXPERIMENT

Preferential order of forms: correlation between ranks for "neutral" forms, and ranks for forms of various colors. (12 obs.; 1st 4 women)

Obs.:	1	2	3	4	5	6	7	8	9	10	11	12
ρ:	0.86	0.94	0.86	0.96	1.00	1.00	1.00	0.86	0.86	1.00	0.94	0.88

Confirmation by an Experiment under Diffused Daylight.— A comparable result was obtained in a preliminary experiment, which was conducted under uncontrolled diffused daylight but with laboratory conditions otherwise similar to those described above. There were 12 observers, 8 men and 4 women, all of whom except one had had only a little previous training in psychological observation. Color preferences were determined for these observers with a series of colored squares; form preferences were determined by the use of a series of forms outlined in black ink on a grey ground. The results were examined to see whether the judgments given for the 49 colored forms occurred as if dependent upon the concurrent independent summative operation of the tendencies effective in the first two series. As indicated in Tables XVIII and XIX, the co-efficients of correlation between the results on colors and forms and the results on color-forms are, without a single exception, very high for all the observers and support convincingly the conclusion reached in the foregoing analyses.

TABLE XX

AV. REACTION-TIMES (SECS.) FOR ALL COLORS OF EVERY FORM

Form	B	D	F	P	Av. 4 obs.	M
S	2.18	1.05	1.15	0.89	1.32	0.45
a	1.88	1.23	1.05	0.91	1.27	0.49
b	2.15	1.09	0.80	0.91	1.24	0.49
c	1.94	1.17	0.67	0.59	1.09	0.50
d	1.76	1.01	0.76	0.71	1.06	0.44
e	1.71	0.69	0.70	0.66	0.94	0.45
f	1.83	0.92	0.57	0.84	1.04	0.48
g	1.53	0.78	0.53	0.77	0.90	0.47
Av.	1.87	0.99	0.78	0.79	1.11	0.47
M.V.	0.17	0.15	0.16	0.11	0.15	0.02

TABLE XXI

AV. REACTION-TIMES (SECS.) FOR ALL FORMS OF EVERY COLOR

Color	B	D	F	P	Av. 4 obs.	M
N	2.19	1.05	0.68	1.25	1.29	0.64
R	2.08	0.92	0.73	0.78	1.13	0.60
O	1.19	0.80	0.63	1.05	0.92	0.65
Y	1.00	0.69	0.78	0.95	0.86	0.51
G	1.26	0.90	0.79	0.92	0.97	0.65
C	1.33	0.76	0.60	1.01	0.93	0.57
B	1.21	0.75	0.70	1.11	0.94	0.51
P	1.17	0.79	0.50	0.95	0.85	0.57
Av.	1.43	0.83	0.68	1.00	0.99	0.59
M.V.	0.35	0.10	0.09	0.10	0.16	0.04

TIME-RELATIONS OF AFFECTIVE JUDGMENTS

Speed.—The data indicating the speed of affective judgments are summarized in Tables XX-XXII. They are fairly comparable with the results of Washburn[24] and Nakashima.[25] Miss Washburn and her collaborators found, with a group of thirty observers, that the average of the average reaction times

[24] H. Potter, R. Tuttle, and M. Washburn, The speed of affective judgments, *Amer. J. Psychol.*, 25, 1914, 288-290.

[25] Nakashima, Time relations of affective processes, *Psychol. Rev.*, 16, 1909, 303-339.

for all the judgments of pleasantness on colors taken together was 1.4 secs. The individual averages ranged from 1 to 2.5. For unpleasantness the average was 1.4, ranging from 1 to 2.5. With another group of twenty-five observers, the average of the average reaction times for judgments of pleasantness, exclusive of extreme judgments, was 1.6; the longest individual average for pleasantness was 2.7 secs., and the shortest

TABLE XXII

AV. REACTION-TIMES (SECS.) FOR COLOR-FORMS FRACTIONATED TO SHOW PRACTICE-EFFECTS

Series	B	D	F	P	Av. 4 obs.	M
1	1.95	1.17	0.94	1.27	1.33	1.14
2	1.86	0.83	0.74	1.22	1.16	0.79
3	1.74	1.02	0.68	1.40	1.21	0.59
4	1.01	0.97	0.82	1.09	0.97	0.69
5	1.69	0.91	0.66	0.87	1.03	0.60
6	1.61	0.84	0.66	0.88	1.00	0.60
7	1.35	0.84	0.67	1.07	0.98	0.58
8	1.09	1.03	0.57	1.05	0.94	0.59
Av. 1-8	1.54	0.95	0.72	1.11	1.08	0.70
9	1.12	1.63	0.56	1.02	1.08	0.64
10	1.40	0.78	0.57	1.00	0.94	0.71
11	1.38	0.83	0.63	0.82	0.92	0.75
12	1.69	0.67	0.60	0.87	0.96	0.50
13	1.56	0.92	0.54	0.99	1.00	0.57
14	2.01	0.85	0.48	0.84	1.05	0.49
15	1.64	0.87	0.61	0.92	1.01	0.39
16	1.54	0.96	0.58	0.82	0.98	0.40
Av. 9-16	1.54	0.94	0.57	0.91	0.99	0.56
17	1.42	0.82	0.50	0.74	0.87	0.34
18	1.66	0.79	0.50	0.87	0.96	0.38
19	1.56	0.75	0.57	0.70	0.90	0.41
20	1.40	0.84	0.56	0.73	0.88	0.46
21	1.58	0.74	0.52	0.82	0.92	0.45
22	1.27	0.90	0.52	0.72	0.85	0.43
23	1.48	0.76	0.60	0.90	0.94	0.52
24	1.45	0.79	0.48	0.85	0.89	0.50
Av. 17-24	1.48	0.80	0.53	0.79	0.90	0.43
Av. of all	1.52	0.90	0.61	0.93	0.99	0.56
M.V.	0.20	0.12	0.08	0.14	0.14	0.13

0.9 secs. The average for unpleasantness, exclusive of extreme judgments, was 1.6 secs., the longest individual average for unpleasantness was 2.4 and the shortest 0.9. In both cases the speed varied with the intensity of affection. Nakashima by employing the direct reaction method found that the shortest time required for an affection to arise varied from 0.84 to 0.98 secs. for colors; and from 0.72 to 1.08 for geometrical figures. With our observers, the average of all the reaction times for colors is 1.11 secs., for forms, 0.99, and for color-forms, 0.99.[26] There are great individual differences due probably to the difference in attitude and in "affective sensitiveness" of the observers.

We find that the average of the reaction time for the comparisons of the most pleasant color-form with the 24 color-forms that come next in the order of preference (B = 0.80; D = 0.72; F = 0.50; P = 0.61 secs.) is greater than the average of the reaction time for the comparisons of the most pleasant color-form with the 24 least pleasant color-forms (B = 0.74; D = 0.63; F = 0.45; P = 0.45 secs.). It appears, therefore, that the speed of affective judgments under the method of paired comparisons varies with the degree of difference in the intensity or quality of the affective tendencies of the two stimuli compared. A similar relation would doubtless hold with sensory judgments.[27]

Effect of Practice.—The effect of practice is not striking except in the first two or three series. It is overshadowed by the presence of the daily fluctuations of reaction times, which are doubtless caused by the variations in psychophysical conditions determining the general efficiency of the observers. A practice-effect may, however, be made apparent by dividing the 24 series of experiments on color-forms into three groups according to the order in which they were conducted, and by comparing the averages of these reaction times. It will be seen (Table XXII) that these averages become shorter and shorter as they advance from the first to the last groups.

Distribution of reaction times.—The frequencies of reaction times in the experiments on colors, forms and color-forms are much skewed. Starting from the lower end, the distribution curve rises quickly to its maximum and falls slowly with

[26] M's results are excluded from the calculation of these averages, since with her the experiments were performed in the reversed temporal order.

[27] *Cf.* S. S. George, Attitude in Relation to the Psychophysical Judgment, *Amer. J. Psychol.*, 28, 1917, p. 33.

the increase in the length of time. This skew is consistent with the fact that the reaction times are limited in negative deviation since they can scarcely be less than a considerable portion of a second, whereas there is no limitation to the delay that may occur in giving judgment.

Conclusions

I. The preferential orders of colors and forms are relatively permanent during a period extending over five months.

II. When color-forms are presented in some particular form for affective comparisons of colors only, the form has practically no influence upon the preferential orders of these colors.

III. When color-forms are presented in some particular color for affective comparisons of forms only, the color has practically no influence upon the preferential order of forms.

IV. As far as relative pleasantness is concerned, color and form are, in the main, mutually independent in conditioning affective tendency of color-form, even though simultaneously operative.

V. The dominance of color or form as independently determining the affective tendency of color-form probably depends directly upon the intensity of its pleasantness or unpleasantness.

VI. (Corollary of IV and V.) Within the dimension of pleasantness and unpleasantness, the affective tendency of color-form varies approximately with the algebraic sum of the affective tendencies of its constituent color and form.

VII. Two types of affective judgments, characterized by sensorial and objective attitudes, can be made under the method of paired comparisons.

VIII. The reaction times for affective judgments are more rapid in the immediate judgment of the objective attitude than in the mediate judgment of the sensorial attitude, and more rapid when the members compared differ widely in affective degree.